

LABORATORY TEST REPORT

RADIO PERFORMANCE MEASUREMENTS

for the

TBCL0E Base Station Transceiver

Tested in accordance with:

FCC 47 CFR Part 90

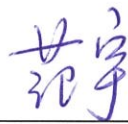
RSS-119 Issue 12
RSS-Gen Issue 4

Class 2 Permissive Change

Report Revision: 1

Issue Date: 10-August-2016

PREPARED BY: Aaron. Fan


Test Technician

CHECKED & APPROVED BY: M. C. James


Laboratory Technical Manager



IANZ
ACCREDITED LABORATORY

OATS FCC LISTING REGISTRATION: 837095

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation.

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TELTEST Laboratories (A Division of Tait Communications)
PO Box 1645, 558 Wairakei Road, Christchurch, New Zealand.

Tele50one: 64 3 358 3399
FAX: 64 3 359 4632

FCC ID: CASTBCL0E
IC : 737A-TBCL0E

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Report Revision: 1
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REVISION

Date	Revision	Comments
10-August-2016	1	Initial test report

INTRODUCTION

Type approval testing of the BASE STATION, 100 Watt, TBCL0E transceiver in order to demonstrate continued compliance with FCC 47 Part 90, and RSS-119 Issue 12 & RSS-Gen Issue 4, after including Analogue FM and FFSK modulation options.
The original test report is TARF 3605

Type Approval Testing of the TBCL0E
Frequency ranges: TX: 927 → 941 MHz, and RX: 896 → 902 MHz

in accordance with:

FCC 47 CFR Part 90
RSS-119 Issue 12 & RSS-Gen Issue 4

REPORT PREPARED FOR

Tait Ltd
245 Wooldridge Road
Harewood
Christchurch 8051
New Zealand

DESCRIPTION OF SAMPLE

Manufacturer Tait Limited
Equipment: BASE STATION Transceiver
Type: TBCL0E
Quantity: 1

TBCL0E Base Station Transceiver consisting of:

FUNCTIONAL DESCRIPTION	PRODUCT DESIGNATION CODE	SERIAL NUMBER (S)
Reciter	T01-01105-QAAA	18203342
Power Amplifier	T01-01136-QBAA	18203259
Power Management Unit	TBA30A0-0100	18203418
Front Panel	T01-01110-CCAA	18203909

Quantity: 1 of each

HARDWARE & SOFTWARE Details:

FUNCTIONAL DESCRIPTION	FIRMWARE VERSION	HARDWARE VERSION
Reciter	dmr-2.20.00.0002	1
Power Amplifier	314	1
Power Management Unit	316	1
Front Panel	1.08.00.0002	0.04

TEST CONDITIONS

All testing was performed between 29 July → 08 August-2016, and under the following conditions:

Ambient temperature: 15°C → 30°C

Relative Humidity: 20% → 75%

Standard Test Voltage 120 V_{AC}

STATEMENT OF COMPLIANCE

We, TELTEST LABORATORIES of 558 Wairakei Road, Christchurch, New Zealand, declare under our sole responsibility that the product:

Equipment: BASE STATION Transceiver
Type: TBCL0E
Quantity: 1

to which this declaration relates, is in conformity with the following standards:

FCC 47 CFR Part 90

RSS-119 Issue 12 & RSS-Gen Issue 4

Signature: 

Mike James
Technical Manager

Date: 

MODULATION TYPES, NECESSARY BANDWIDTH & EMISSION DESIGNATORS

MODULATION TYPES:

FXD	Digital Data	4800 symbols/sec	9600 bps
FXW	Digital Voice / Data	4800 symbols/sec	9600 bps
F3E	FM Analogue Voice	-	-
F2D	Fast Frequency Shift Keying	1200 symbols/sec	1200 bps

CHANNEL SPACINGS: 12.5 kHz

EMISSION DESIGNATORS:

Analogue Voice	11k0F3E
FFSK	7K60F2D
DMR Digital Voice / Data	7K60FXW
DMR Digital Data	7K60FXD

Digital Mobile Radio (DMR) 4 level FSK (as per ETSI TS 102 361-1)
4800 symbols/sec 9600 bps

Digital Data 12.5 kHz Channel
99% bandwidth
= 7.6 kHz

Emission Designator
7K60FXW
FXW represents FM combination of data and telephony.

Digital Data 12.5 kHz Channel Spacing
99% bandwidth
= 7.6 kHz

Emission Designator
7K60FXD
FXD represents FM data only

Equation: $B_n = 2M + 2Dk$
(M is highest modulating frequency; D is peak allowable deviation; k is a constant of 1 for FM)

Analogue Voice 12.5 kHz Channel Spacing

Necessary bandwidth
M = 3.0 kHz
D = 2.5 kHz

$$B_n = (2 \times 3.0) + (2 \times 2.5) \times 1$$

$$= 11.0 \text{ kHz}$$

Emission Designator
11K0F3E
F3E represents an FM voice transmission

Fast Frequency Shift Keying (FFSK – 1200 bps) 12.5 kHz Channel Spacing

Necessary bandwidth
M = 1.8 kHz
D = 2.0 kHz

$$B_n = (2 \times 1.8) + (2 \times 2.0) \times 1$$

$$= 7.6 \text{ kHz}$$

Emission Designator
7K60F2D
F2D represents a FM data transmission with the use of a modulating sub carrier

TEST RESULTS

TRANSMITTER AUDIO FREQUENCY RESPONSE - PRE-EMPHASIS

SPECIFICATION: FCC 47 CFR 2.1047 (a)

GUIDE: TIA/EIA-603D 2.2.6

MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment set up.
2. An audio input tone of 1000 Hz was applied with the level set to obtain 20% of maximum deviation. This was used as the 0 dB reference point.
3. The AF was varied while the audio level was held constant.
4. The response in dB relative to 1000 Hz was measured.

MEASUREMENT RESULTS:

See the plots on the following pages for 12.5 kHz channel spacing tested at 100 W transmit power.

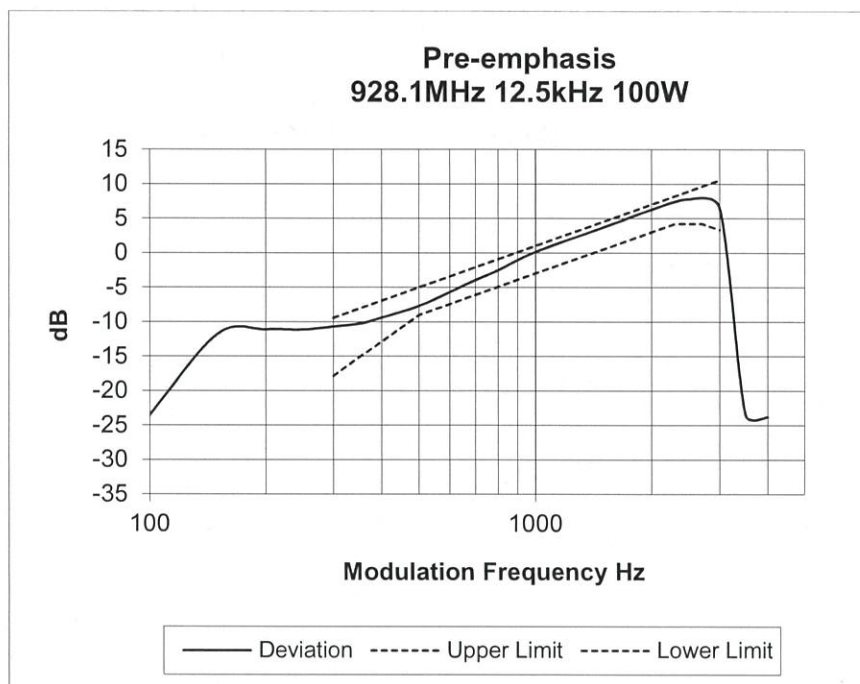
LIMIT CLAUSE: TIA/EIA-603D 3.2.6

Transmitter Audio Frequency Response – Pre-emphasis

SPECIFICATION: FCC CFR 2.1047 (a)

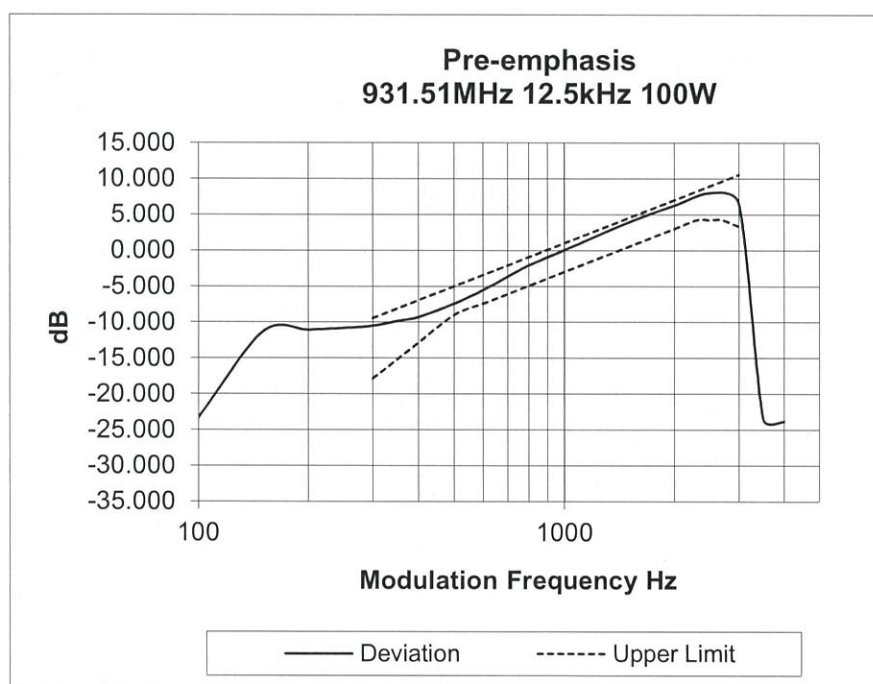
Tx FREQUENCY: 928.1 MHz

12.5 kHz Channel Spacing



Tx FREQUENCY: 931.51 MHz

12.5 kHz Channel Spacing

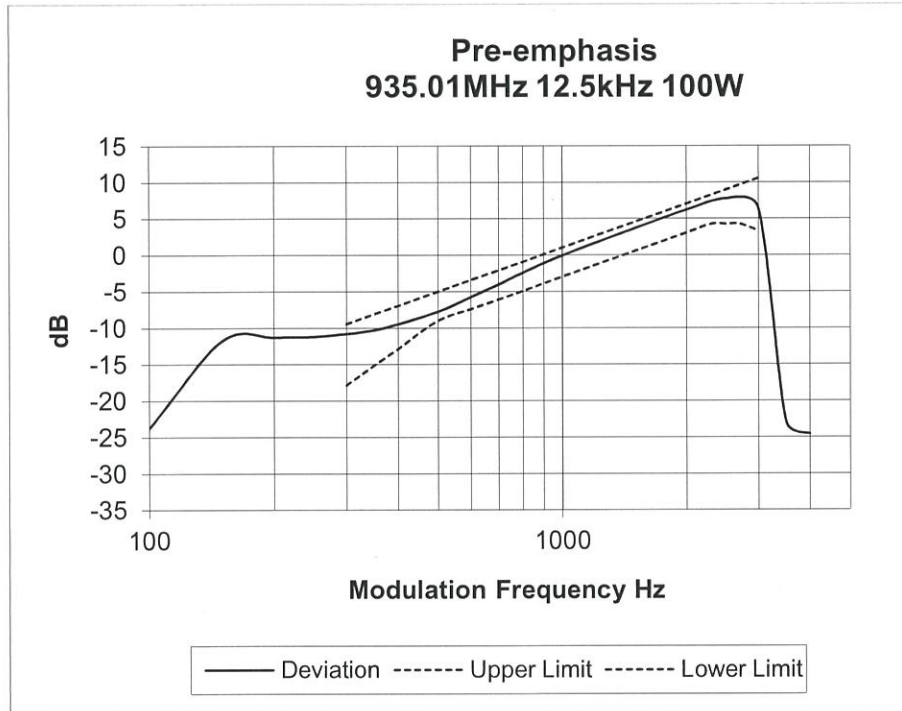


Transmitter Audio Frequency Response – Pre-emphasis

SPECIFICATION: FCC CFR 2.1047 (a)

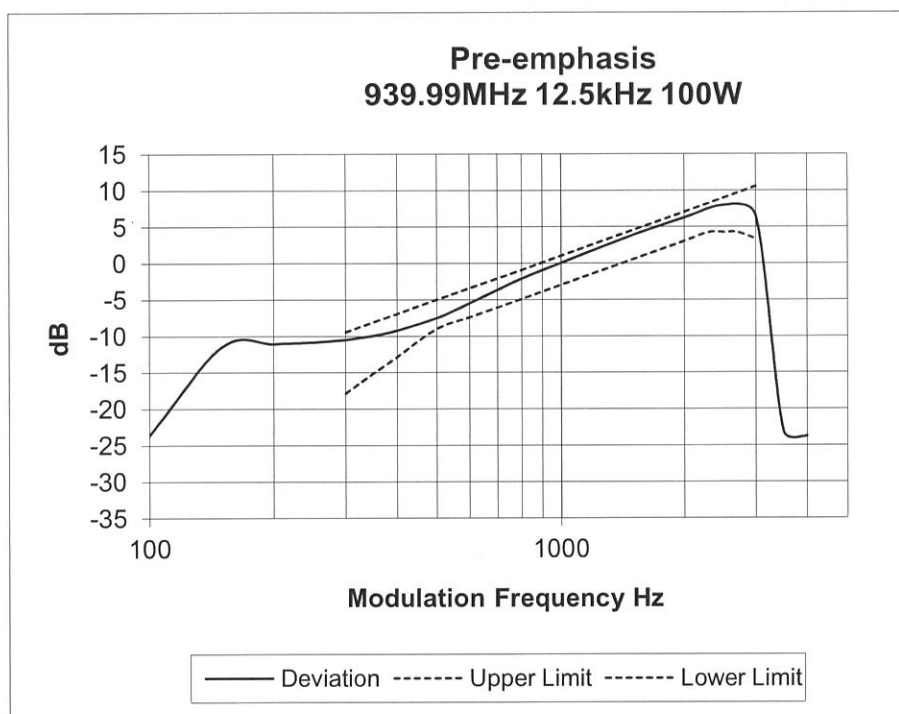
Tx FREQUENCY: 935.01 MHz

12.5 kHz Channel Spacing



Tx FREQUENCY: 939.99 MHz

12.5 kHz Channel Spacing



TRANSMITTER MODULATION LIMITING

SPECIFICATION: FCC 47 CFR 2.1047 (b)

GUIDE: TIA/EIA-603D 2.2.3

MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment set up.
2. The modulation response was measured at three audio frequencies while varying the input level.
3. Measurements were made for both Positive and Negative Deviation.

MEASUREMENT RESULTS:

See the plots on the following pages for 12.5 kHz channel spacing.

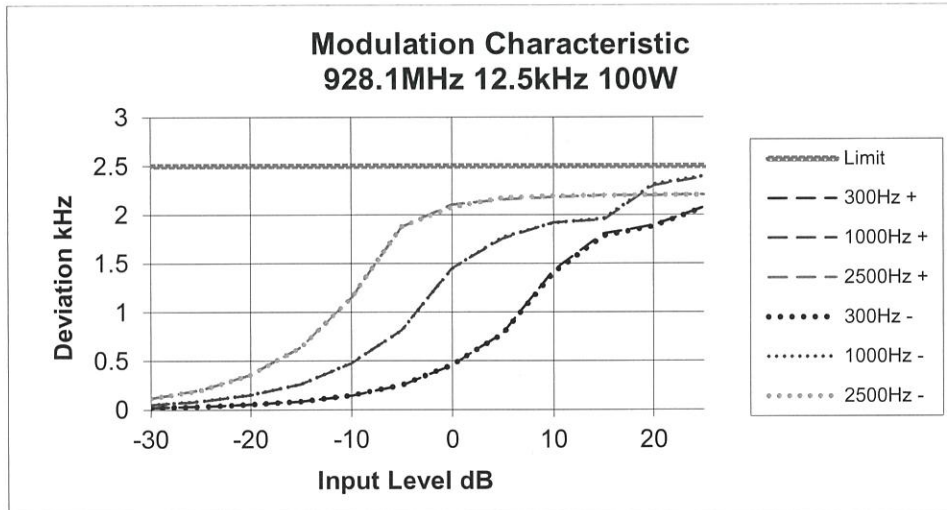
LIMIT CLAUSE: TIA/EIA-603D 1.3.4.4

Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

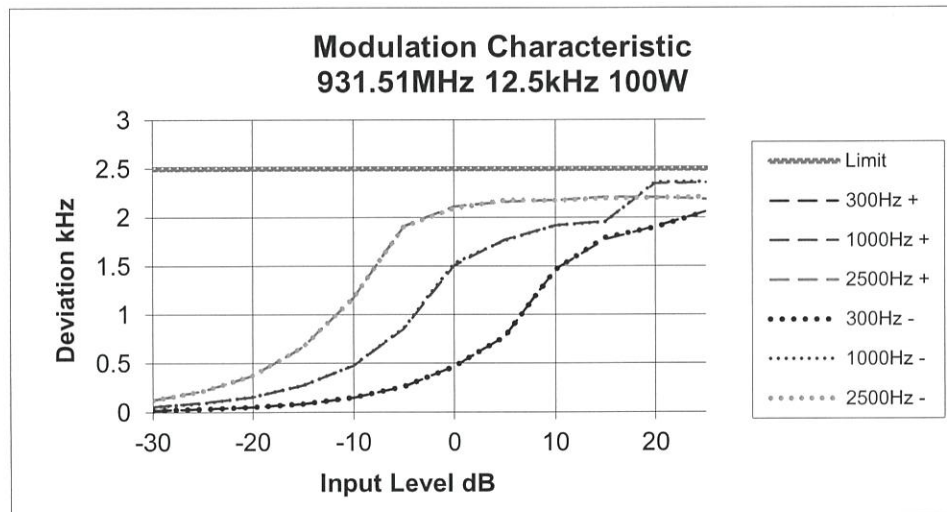
Tx FREQUENCY: 928.1 MHz

12.5 kHz Channel Spacing



Tx FREQUENCY: 931.51 MHz

12.5 kHz Channel Spacing

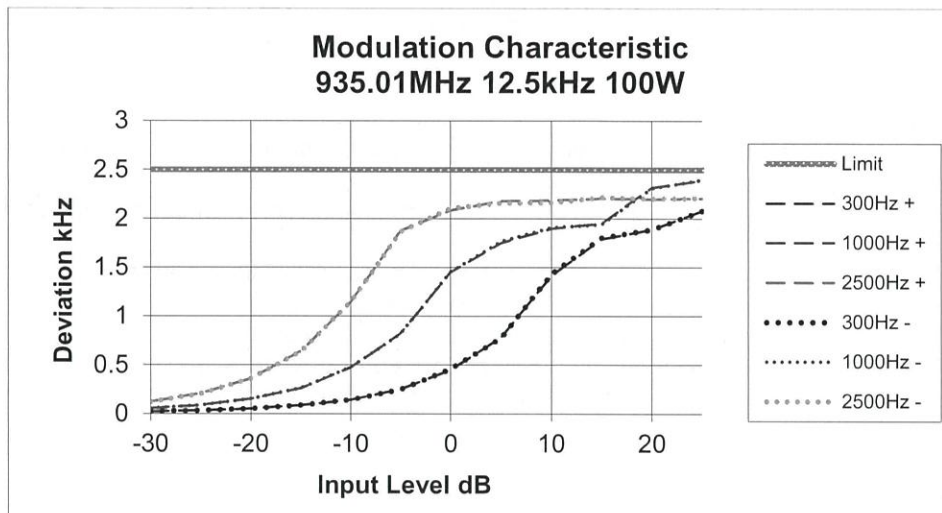


Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

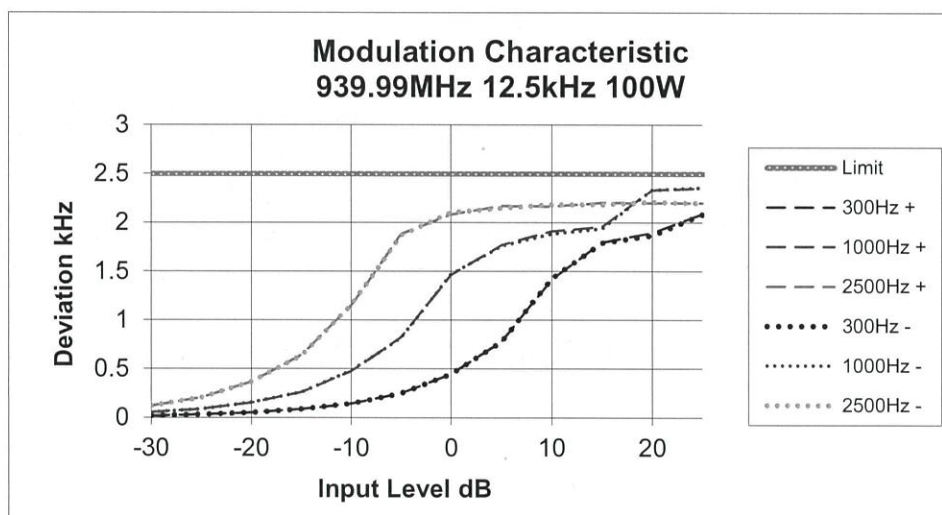
Tx FREQUENCY: 935.01 MHz

12.5 kHz Channel Spacing



Tx FREQUENCY: 939.99 MHz

12.5 kHz Channel Spacing



TRANSMITTER OCCUPIED BANDWIDTH AND SPECTRUM MASKS

SPECIFICATION: FCC 47 CFR 2.1049 (c)

RSS-119 5.5

GUIDE: TIA/EIA-603D 2.2.11 (Analog)
TIA-102.CAAA-C 2.2.5 (Digital)

MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment Set up.
The EUT was modulated with an internally generated pseudo random bit sequence at the appropriate Baud rates.
2. The Occupied Bandwidth was measured on the Spectrum Analyser, with bandwidth settings as follows.
Emission Mask D – Resolution Bandwidth = 100 Hz, Video Bandwidth = 1 kHz
Emission Mask B – Resolution Bandwidth = 300 Hz, Video Bandwidth = 3 kHz
Emission Mask G – Resolution Bandwidth = 300 Hz, Video Bandwidth = 3 kHz
Emission Mask I – Resolution Bandwidth = 300 Hz, Video Bandwidth = 3 kHz
Emission Mask J – Resolution Bandwidth = 300 Hz, Video Bandwidth = 3 kHz

MEASUREMENT RESULTS:

See the plots on the following pages for 12.5 kHz & 25.0 kHz channel spacings.

LIMIT CLAUSE: FCC 47 CFR 90.210

RSS-119 5.5

EMISSION MASKS APPLICATION TABLE

Standard	Analogue		FFSK	
	RSS-119 5.5	FCC CFR2.1049	RSS-119 5.5	FCC CFR2.1049
928.1MHz	D	-	D	-
931.5125MHz	B	-	J/G	-
935.0125MHz	I	I	J	J
939.9875MHz	I	I	J	J

DATA SPEED

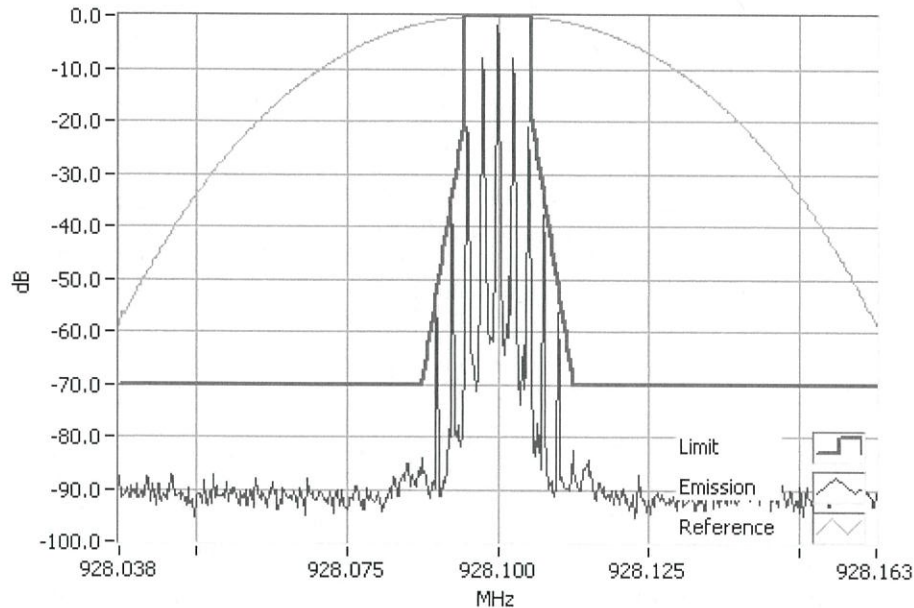
FFSK 12.5 kHz Channel Spacing 1200 bps

Occupied Bandwidth and Spectrum Masks

SPECIFICATION:

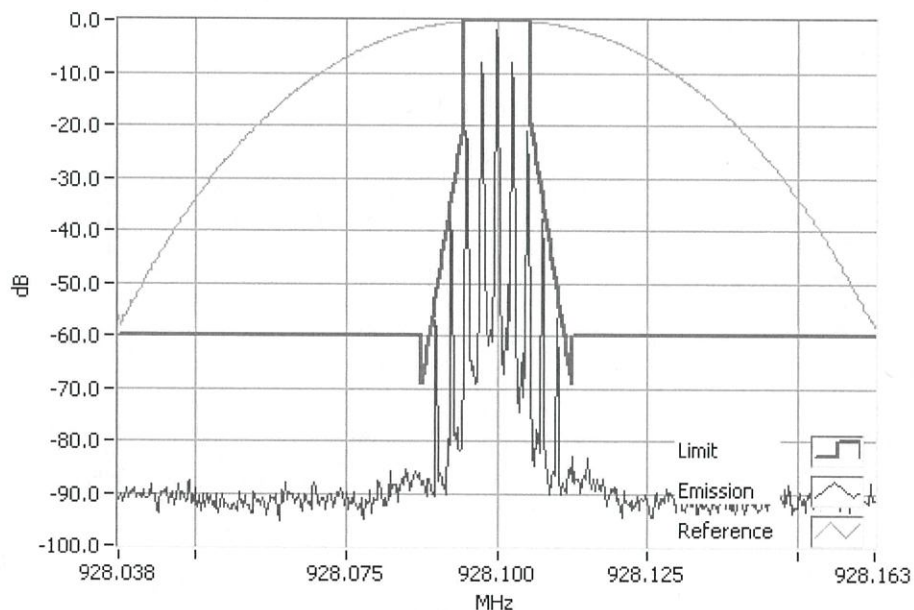
RSS-119 5.5

Tx FREQUENCY: 928.1 MHz 100 W 12.5 kHz Channel Spacing



Analogue Modulation 928.1000MHz Mask D 100W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 928.1 MHz 10 W 12.5 kHz Channel Spacing



Analogue Modulation 928.1000MHz Mask D 10W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

SPECIFICATION:

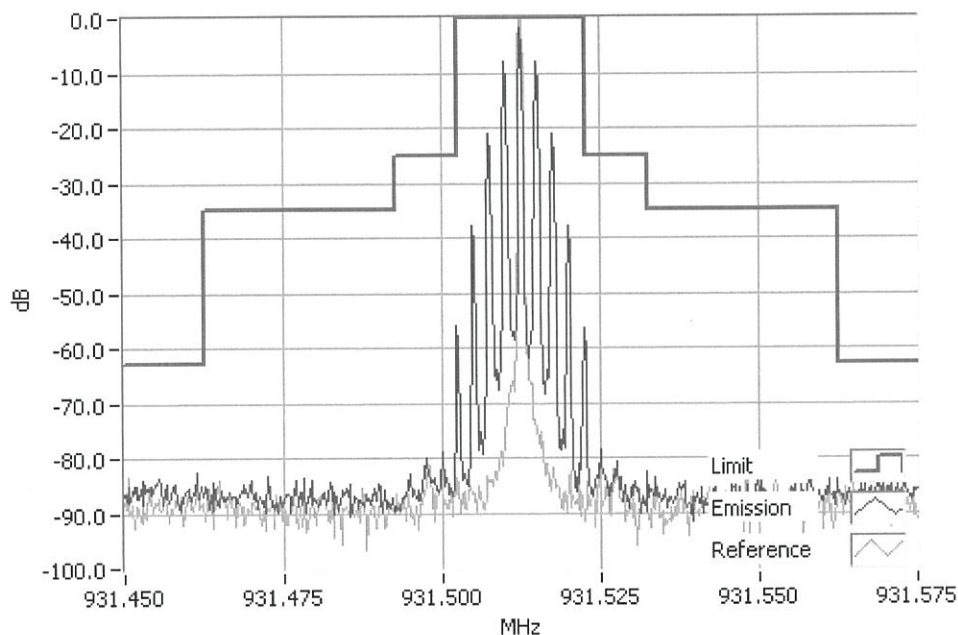
RSS-119 5.5

Tx FREQUENCY:

931.5125 MHz

100 W

12.5 kHz Channel Spacing



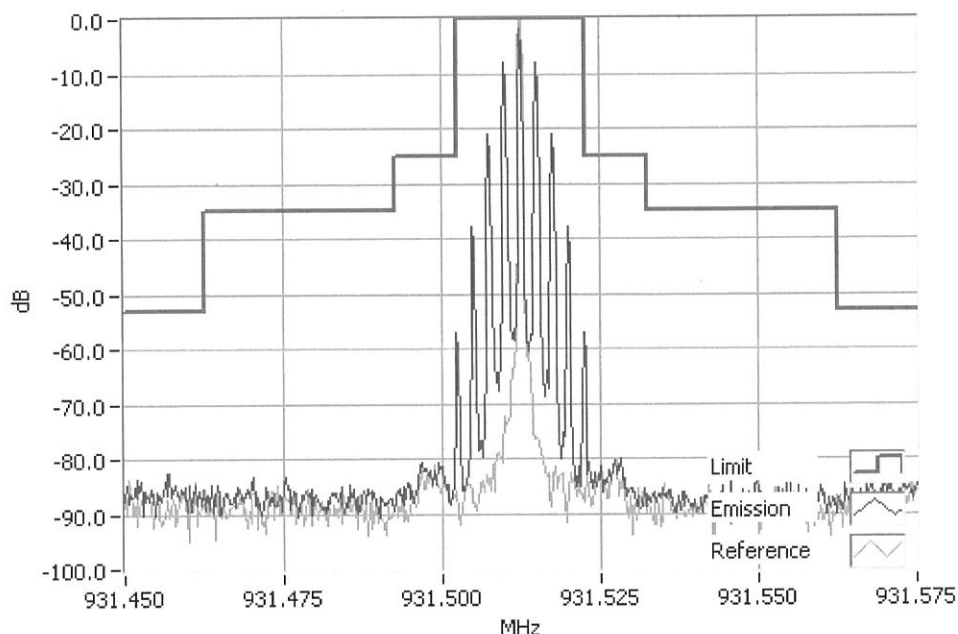
Analogue Modulation 931.5125MHz Mask B 100W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY:

931.5125 MHz

10 W

12.5 kHz Channel Spacing



Analogue Modulation 931.5125MHz Mask B 10W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

SPECIFICATION:

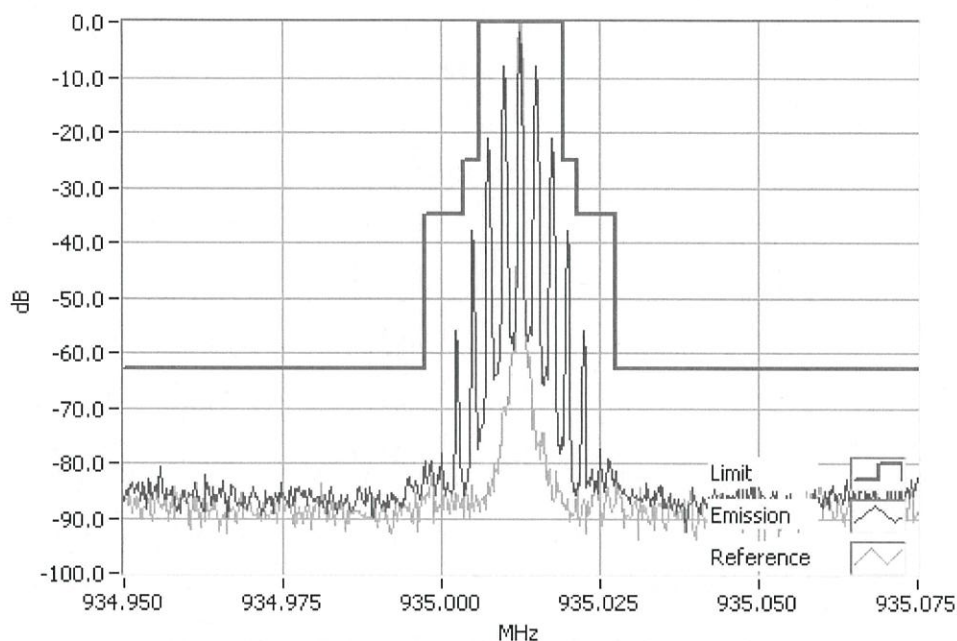
FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY:

935.0125 MHz

100 W

12.5 kHz Channel Spacing



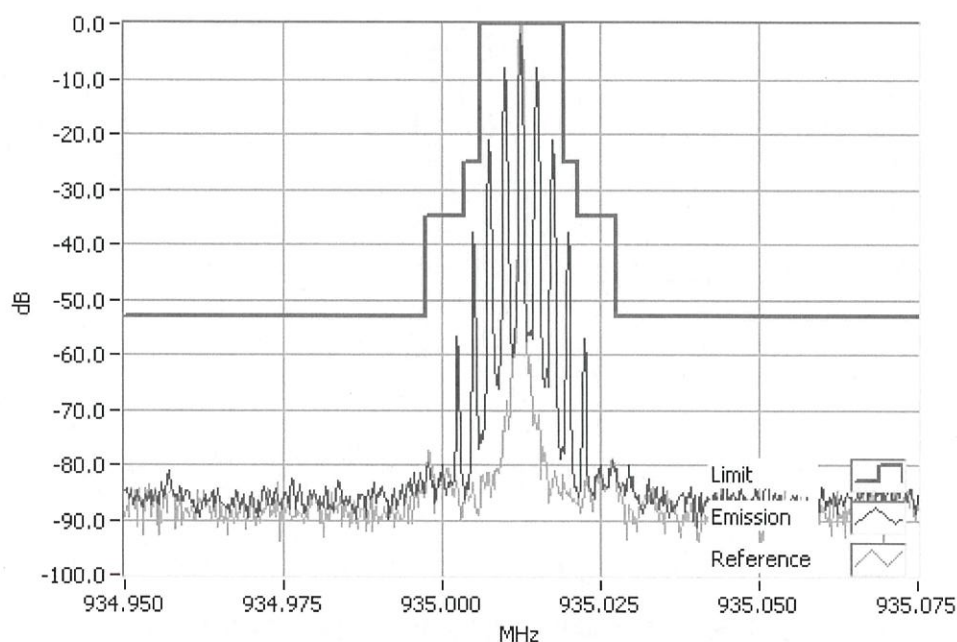
Analogue Modulation 935.0125MHz Mask I 100W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Fails Unmodulated

Tx FREQUENCY:

935.0125 MHz

10 W

12.5 kHz Channel Spacing



Analogue Modulation 935.0125MHz Mask I 10W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

SPECIFICATION:

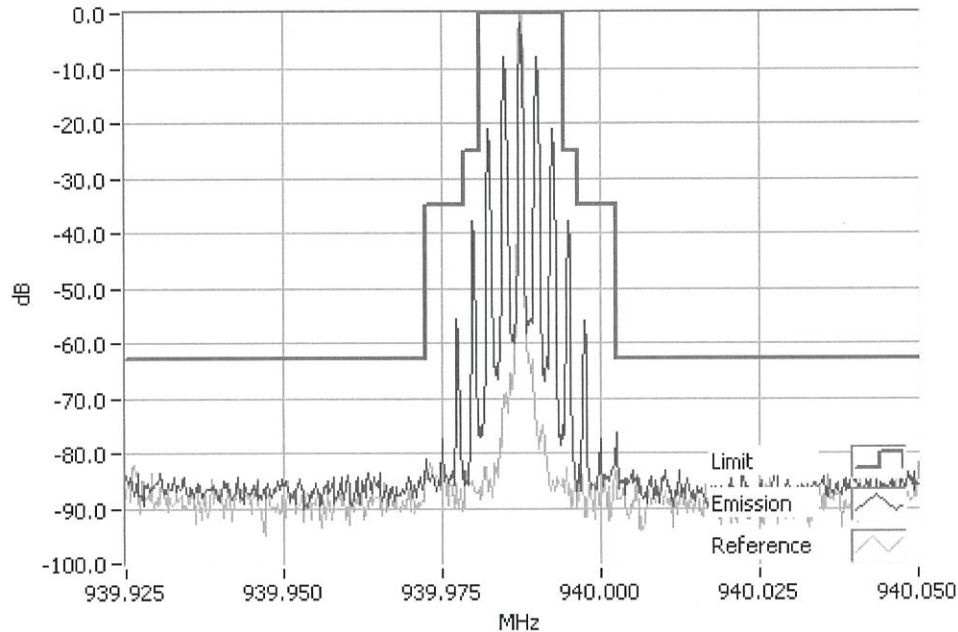
FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY:

939.9875 MHz

100 W

12.5 kHz Channel Spacing



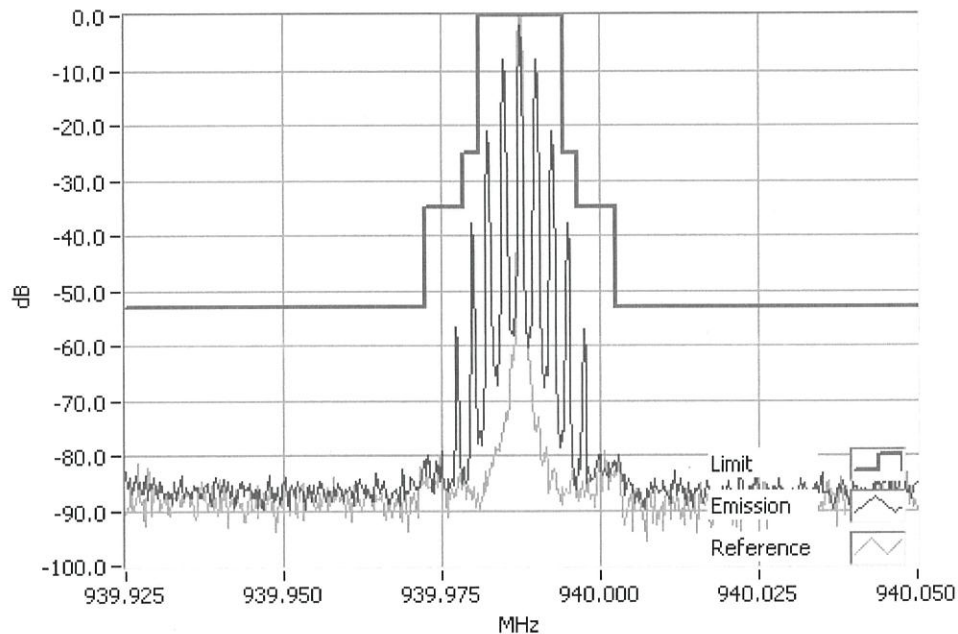
Analogue Modulation 939.9875MHz Mask I 100W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Fails Unmodulated

Tx FREQUENCY:

939.9875 MHz

10 W

12.5 kHz Channel Spacing



Analogue Modulation 939.9875MHz Mask I 10W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

SPECIFICATION:

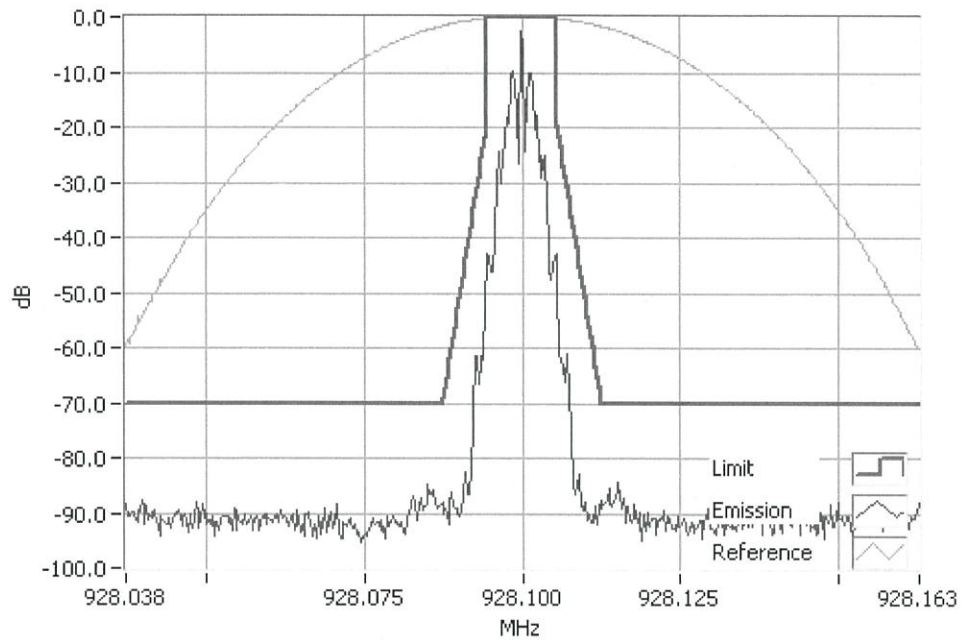
RSS-119 5.5

Tx FREQUENCY:

928.1 MHz

100 W

12.5 kHz Channel Spacing



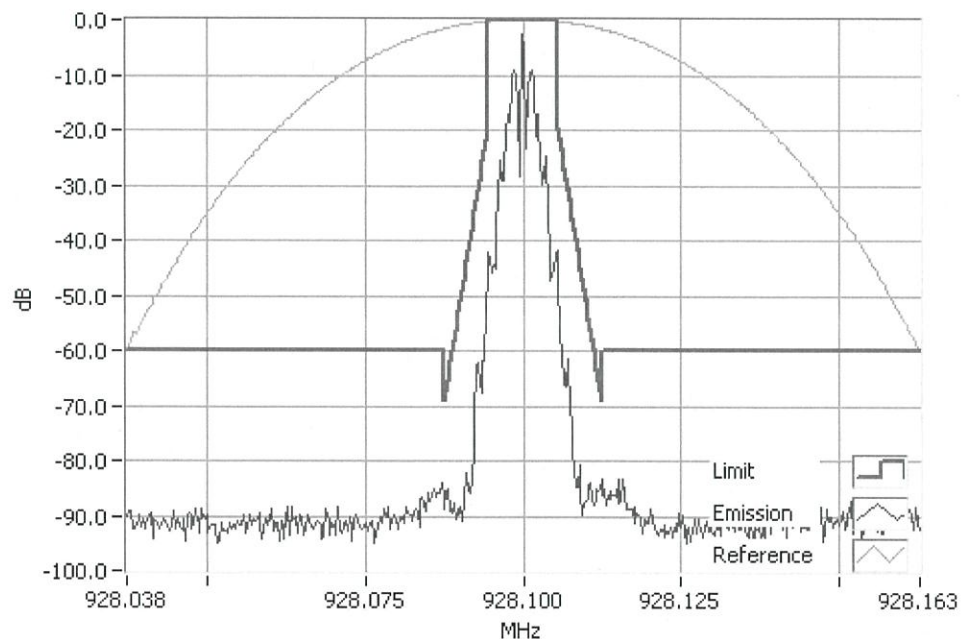
FFSK 928.1000MHz Mask D 100W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY:

928.1 MHz

10 W

12.5 kHz Channel Spacing



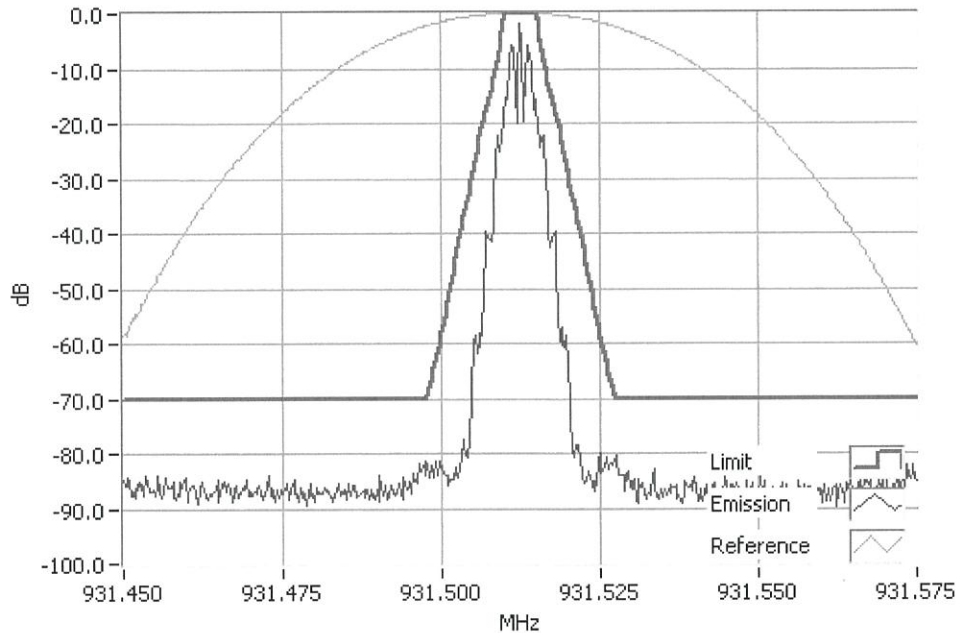
FFSK 928.1000MHz Mask D 10W
RBW=100Hz, VBW=1000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

SPECIFICATION:

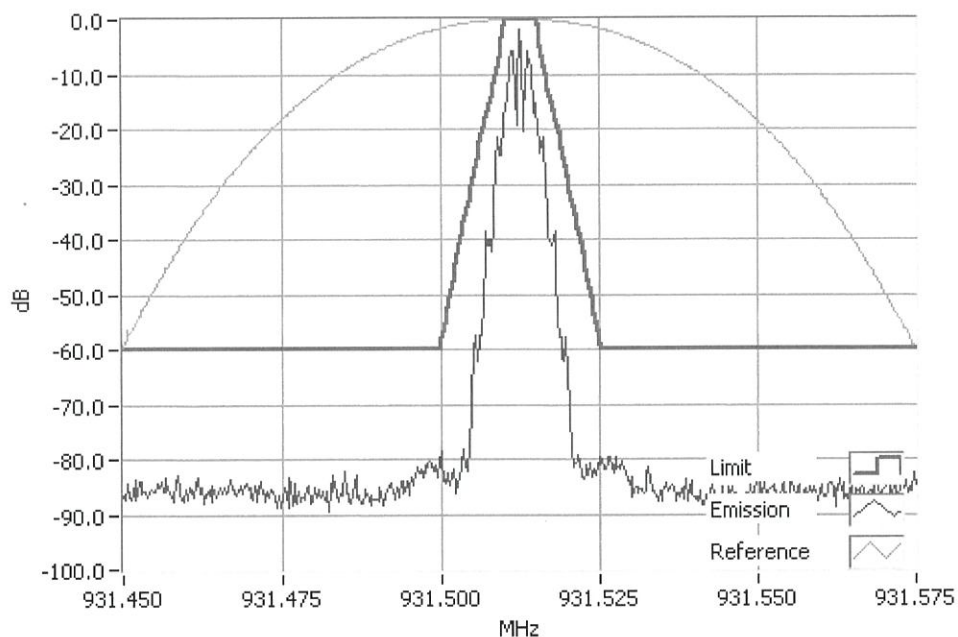
RSS-119 5.5

Tx FREQUENCY: 931.5125 MHz 100 W 12.5 kHz Channel Spacing



FFSK 931.5125MHz Mask J 100W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 931.5125 MHz 10 W 12.5 kHz Channel Spacing



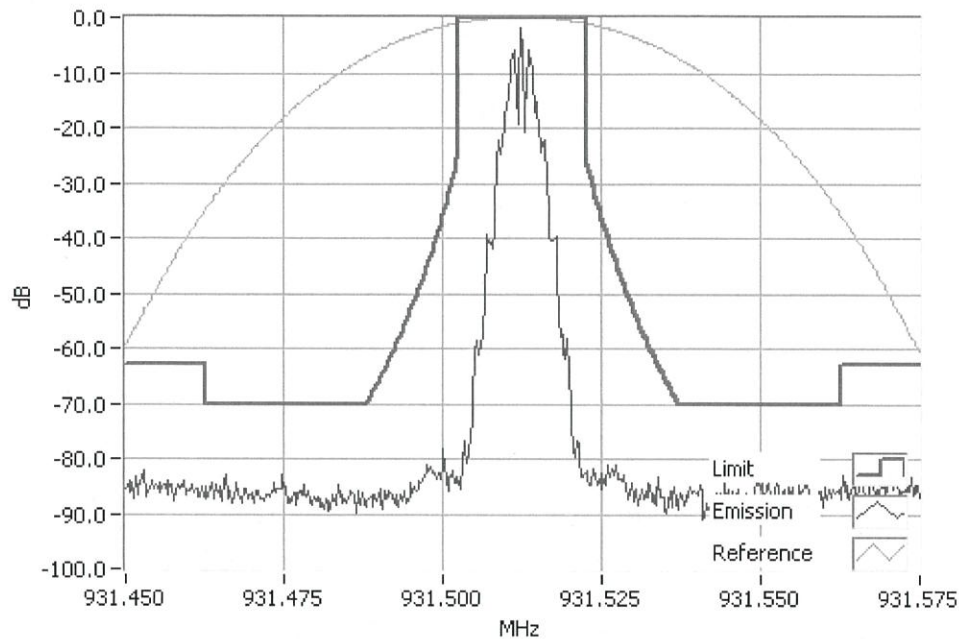
FFSK 931.5125MHz Mask J 10W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

SPECIFICATION:

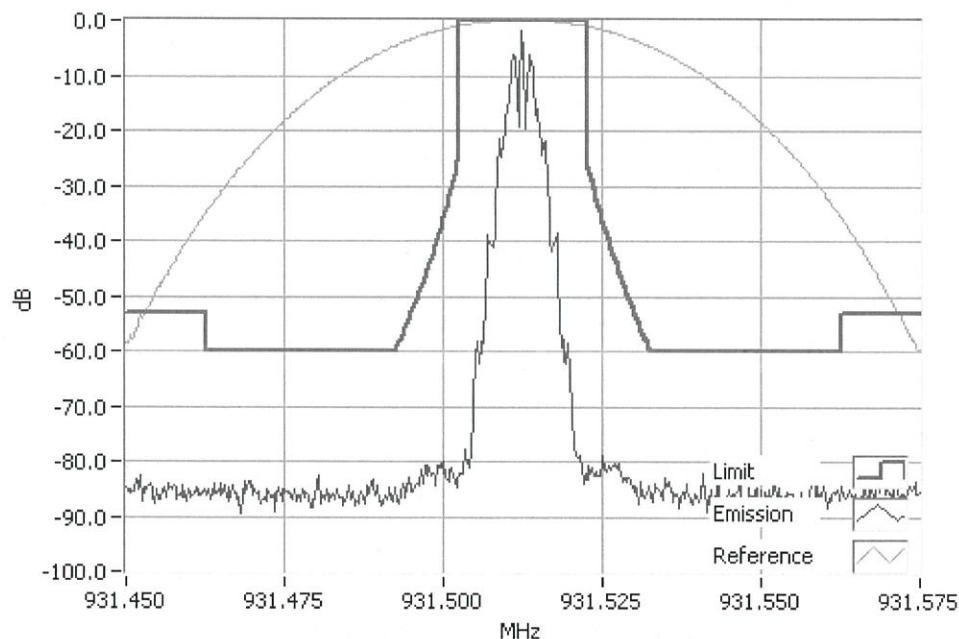
RSS-119 5.5

Tx FREQUENCY: 931.5125 MHz 100 W 12.5 kHz Channel Spacing



FFSK 931.5125MHz Mask G 100W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY: 931.5125 MHz 10 W 12.5 kHz Channel Spacing



FFSK 931.5125MHz Mask G 10W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

SPECIFICATION:

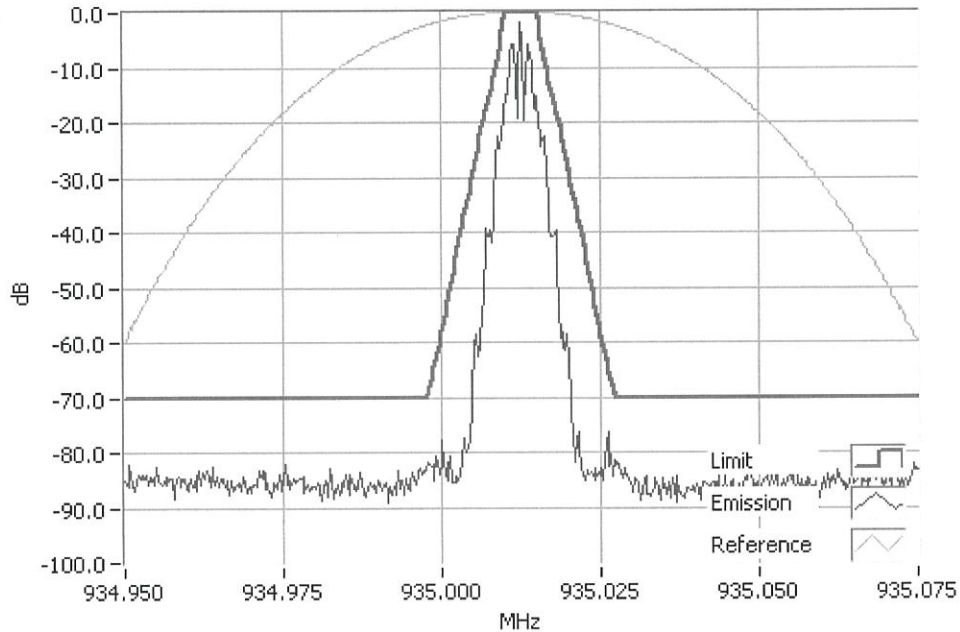
FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY:

935.0125 MHz

100 W

12.5 kHz Channel Spacing



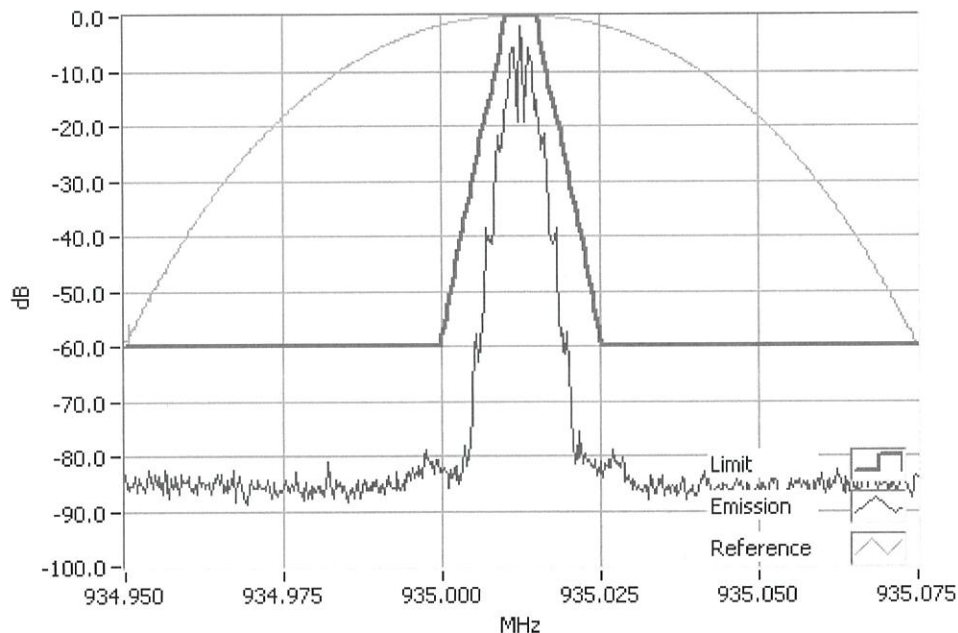
FFSK 935.0125MHz Mask J 100W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY:

935.0125 MHz

10 W

12.5 kHz Channel Spacing



FFSK 935.0125MHz Mask J 10W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

Occupied Bandwidth and Spectrum Masks

SPECIFICATION:

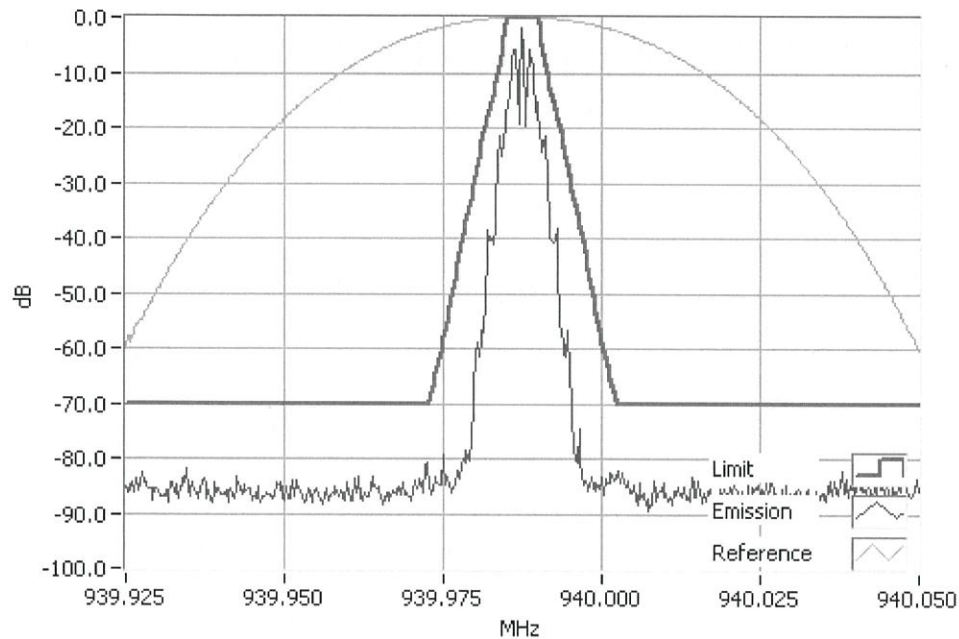
FCC CFR 2.1049 (c) RSS-119 5.5

Tx FREQUENCY:

939.9875 MHz

100 W

12.5 kHz Channel Spacing



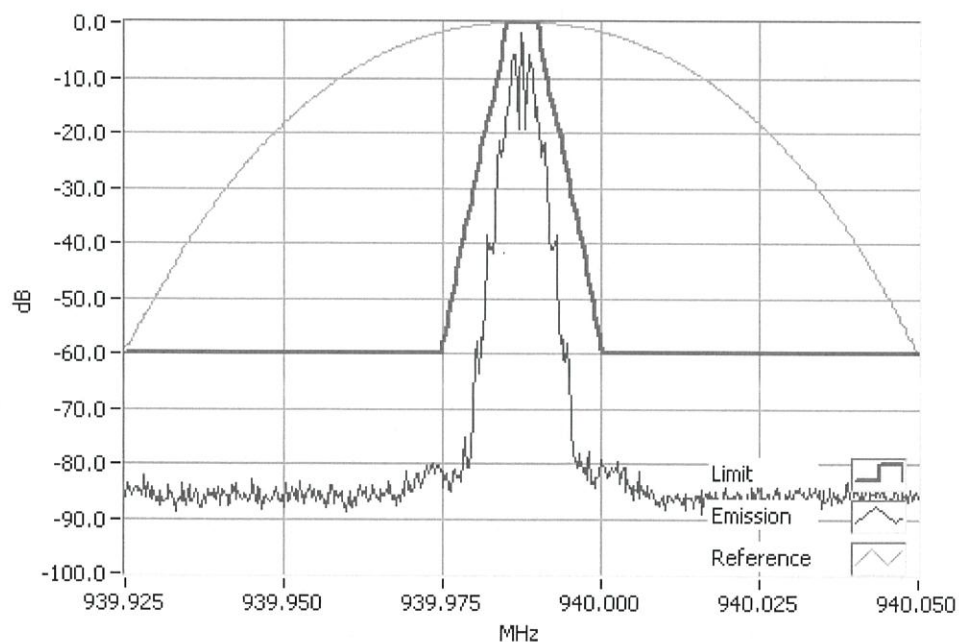
FFSK 939.9875MHz Mask J 100W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

Tx FREQUENCY:

939.9875 MHz

10 W

12.5 kHz Channel Spacing



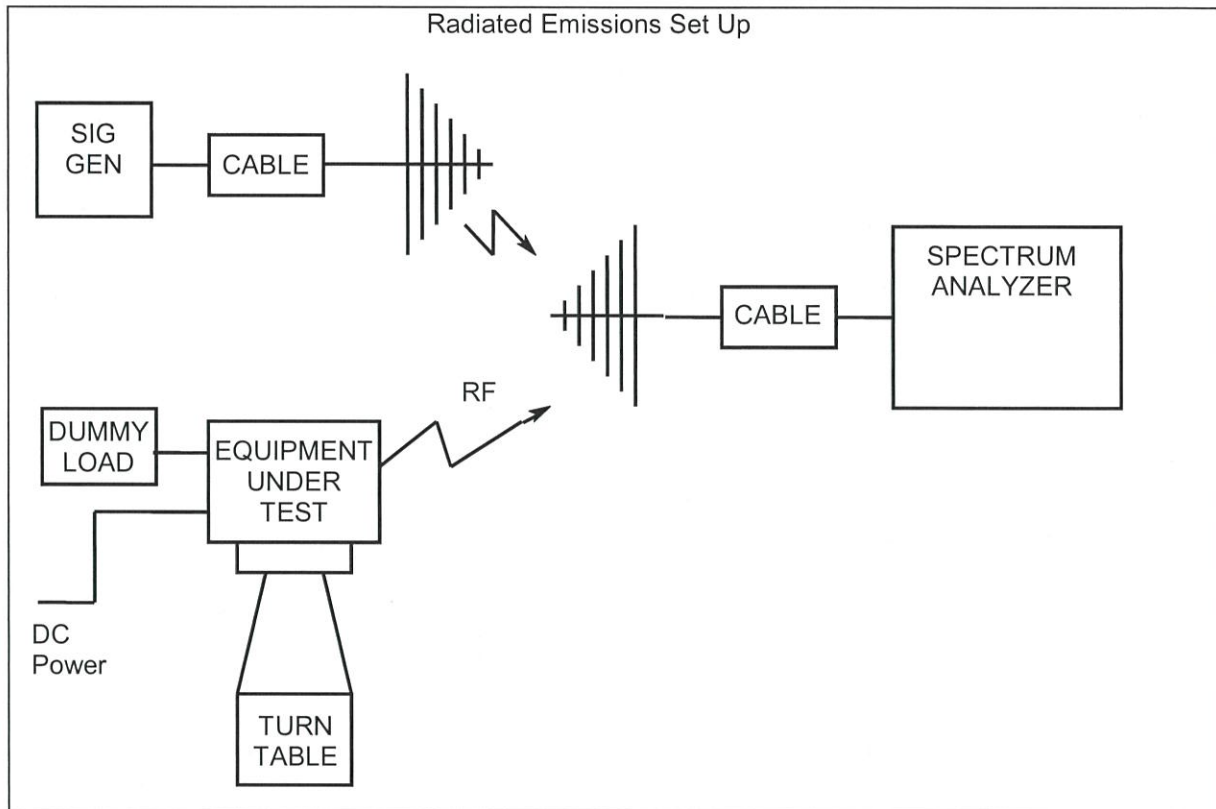
FFSK 939.9875MHz Mask J 10W
RBW=300Hz, VBW=3000Hz, Detector Mode=Peak
Result=Pass

TEST EQUIPMENT LIST

NOTE: Items without calibration dates are calibrated immediately before use, or set using calibrated instruments.

Equipment Type	Information	Manufacturer	Model No	Serial No#	Tait ID	Cal Due
Modulation Analyser	TREVA1	Hewlett Packard	HP8901B (Opt 002)	2441A00393	E3073	21-Oct-16
Audio Analyser	TREVA1	Hewlett Packard	HP8903A	2437A04625	E4986	21-Oct-16
Power Supply	AC Variac	Yamabishi	S-260-5	TX-533	E1737	
Spectrum Analyser	26.5GHz	Agilent	PXA N9030A	MY49432161	E4907	29-Oct-16
Coax Cable	2m Black	Suhner	RG214HF/Nm/Nm/2000	TeltestBlack2	E4623	18-Oct-16
Coax Cable	2m Black	Suhner	RG214HF/Nm/Nm/2000	TeltestBlack4	E4653	16-Oct-16
RF Combiner	TREVA1	Minicircuits	ZFSC-4-1	-	E4083	
RF Attenuator	30dB 350W	Weinschel	67-30-33	BR0531	E4280	18-Oct-16
TREVA 1		Teltest	-	1	-	14-Nov-16

ANNEX A – TEST SETUP DETAILS



All other testing is performed using the Teltest Radio **EVAL**uation system (TREVA), which is configured as shown below. The Spectrum Analyser is connected to the EUT via the attenuator network for Conducted Emissions testing, and Occupied Bandwidth.

